Quasi 3D Photonic Crystal Structures on SOI

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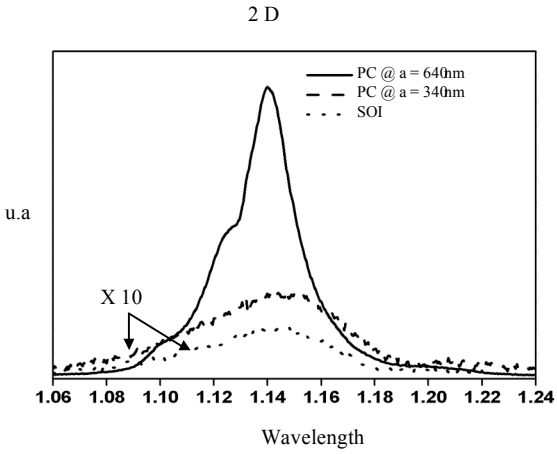
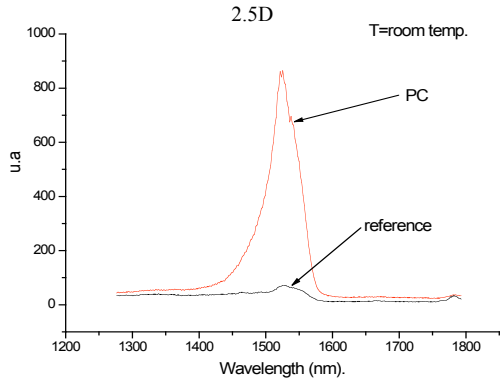
So far optical confinement in 3 dimensions has been demonstrated but still requires hard technological steps. We propose here a new way of realising optical confinement in the three space dimensions by assembling SOI based 2D and 1D photonic crystals (PC).From that quasi 3D samples were designed, build, and optically characterised.

We have first made one dimension silicon photonic crystals, called silicon on mirror (SOM),by bonding a SOI substrate and SiO_2/Si_3N_4 multilayers. These SOM, designed for 1.15µm or 1.54µm, where then associated with 2D PC. These 2D PC had been previously optically characterised and showed light extraction enhancement up to 70 times at low temperature for devices working at1.15µm and up to 20 at room temperature for those designed for 1.54µm.Then these 2D+1D boxes were experimentally investigated and showed light extraction enhancement up to 30 times at room temperature.





Finally we did calculation in such 2.5D photonic devices and point out the important role of the SiO_2 spacer layer between the 2D PC and the Bragg reflector. We show, that according to the thickness of this layer, the coupling of the 2D and the 1D PC can be tuned and thus the Q of the 2D PC or light extraction from the top can be greatly enhanced.